Free Communications, Oral Presentations: Postural Control

Saturday, June 23, 2:45PM-4:15PM, Room 303, Level 2; Moderator: Carl G. Mattacola, PhD, ATC

Effects Of Elastic Tubing Exercises On Postural Balance And Peroneus Longus Latency

Han KM, Schulthies SS, Ricard MD, Fellingham GW: Brigham Young University, Provo, UT

Objective: To determine the effectiveness of four elastic tubing exercises (front pull, back pull, crossover, & reverse crossover) on postural balance and peroneus longus latency in subjects with and without a history of sprained ankles.
Design & Setting: Independent variables were treatment type (exercise or no exercise) and symptomatic status (symptomatic or asymptomatic). Dependent variables were postural balance (total distance traveled) and peroneus longus latency following sudden inversion.
Subjects: A total of 40 collage age subjects (20 male, 20 female; 20 symptomatic, 20 asymptomatic) participated in this study. Symptomatic subjects were recruited who had experienced one or more ankle sprains within the past twelve months and at least two or more ankle sprains within the past 36 months but, at the time of the study, had no visual swelling or pain. Another 20 subjects who had not experienced an ankle sprain within the past 36 months were recruited as asymptomatic subjects. All subjects had no history of fracture or major surgery in either lower extremity.
Measurements: Dependent variables were measured before and after 4 weeks of treatment (elastic tubing exercise or no exercise), and after an additional 4 weeks of detraining to determine the residual effects.
Data Analysis: The data were analyzed in using a random coefficient growth curve model as implemented in SAS Proc Mixed to determine intercepts and slopes for each dependent variable, during exercise phase and the rest phase of this study. Growth curve intercepts and slopes of the different groups were compared for differences using t-test with an alpha < 0.01 as the critical level of significance.
Results: Elastic tubing exercise group improved postural balance significantly more than the no exercise group ($t = 5.09$, $p < 0.0001$). Improvement was greater in the symptomatic group than in the asymptomatic group ($t = 2.75$, $p < 0.0095$). Balance improvement was not significantly changed following 4 weeks of detraining. No differences were found on peroneus longus latency at any time.
Conclusions: The postural balance was improved after 4 weeks of elastic tubing exercise in subjects with and without a history of lateral ankle sprains. This improvement was not changed for 4 weeks following the treatment cessation.

Predictors For Performance Of Dynamic Postural Control Using The Star Excursion Balance Test

Gribble PA, Hertel J, Piegaro AB: Athletic Training Research Laboratory, Pennsylvania State University, University Park, PA

The star excursion balance test (SEBT) has been shown to be a valid and reliable assessment of lower extremity dynamic postural control. It has been previously shown that static postural control measures can be affected by foot type. The purpose of this study was to examine the role of foot type, leg length, and ROM measurements on excursion measurements while performing the SEBT. Thirty healthy subjects (12 males, 18 females, age 22.7667 ± 2.6513 yrs, height 171.5346 ± 7.8458 cm, mass 68.8625 ± 13.0378 kg) participated in the study. Foot type was quantified bilaterally by the same researcher using previously described methods. There were 22 pes planus, 26 pes rectus, 12 pes cavus feet. Additionally, leg length, hip internal and external rotation, and ankle dorsiflexion ROM were measured. Beginning with a right stance leg, subjects were instructed to practice the SEBT reaching in eight directions, given the cues to reach as far as possible and return to the starting position without touching down. Based on previous study, subjects were instructed to perform six practice trials in each of the eight directions. After a sixty-second rest, three trials were performed consecutively in each direction. At the completion of the twenty-four trials, another sixty-second rest period occurred and the practice trials and test trials were repeated while standing on the left leg. There were no significant differences in excursion distance between the right and left limbs of subjects. Analysis of variance revealed no significant differences between foot type and excursion distance. Regression analysis revealed significant correlations between height and excursion distance and leg length and excursion distance in the anterior, anterolateral, posterior, posteromedial, medial, and anteromedial directions ($p<.05$). No significant correlations were found between ROM at the ankle and hip and excursion distances in any direction. Based on the results of this study, we can conclude that when performing a test of dynamic stability, it is not necessary to match subjects according to foot type and hip rotation or ankle dorsiflexion ranges of motion; however, subjects should be matched for height and leg length.

Relationship Between Static, Dynamic And Functional Single Leg Postural Control Performance

Riemann BL, Schmitz RJ, Jackson SA: Applied Neuromechanics Research Laboratory, University of North Carolina-Greensboro, Greensboro, NC

Multiple postural assessment approaches have been developed and utilized secondary to examining different aspects of postural control. The purpose of this investigation was to determine if relationships in performance existed between six different tasks representing static, dynamic and functional postural control performance. Fifty-four recreationally active participants (23 males, 31 females, age=21.9±3.4yrs, weight=69.2±12.9 kg, height=174.1±25.4 cm) attended one 25 minute testing session. In a counterbalanced order, each subject completed 6 single leg (dominant limb) postural control tasks: fixed surface/eyes open (FIEO), fixed surface/eyes closed (FIEC), multiaxial surface/eyes open (MAEO), multiaxial surface/eyes closed (MAEC), star excursion balance test (STAR) and the single leg hop-stabilization test (SLHST). The fixed and multiaxial (Balance Board, Gordon, Inc.) surface tasks were conducted on a forceplate (Bertec, Inc.). During each trial, participants were asked to stand as motionless as possible in a standardized testing position. Force and moment outputs from the forceplate were used to calculate the average center of pressure velocity during the middle 5 seconds across three 7 second trials under each surface and visual condition. For the STAR, participants were required to maintain equilibrium on their dominant limb while extending their contralateral limb in 8 different directions. A grand average across 3 trials in each of the 8 directions was calculated and normalized to body height. The SLSHT required subjects to perform a series of targeted single leg hops while maintaining equilibrium. The total score (landing + balancing errors) was used to represent functional postural control performance. Pearson bivariate correlations were conducted between the six outcome variables ($p<.05$). Results of the analysis revealed a significant moderate correlations between FIEO and FIEC ($r=.550$, $p<.001$), FIEC and MAEC ($r=.546$, $p<.001$) and MAEO and MAEC ($r=.559$, $p<.001$) and significant weak correlations between FIEO and MAEO ($r=.297$, $p=.038$) and FIEO and MAEC ($r=.474$, $p<.001$). The results of this investigation suggest while performance of stabilization tasks on either firm or multiaxial surfaces is related, they are unrelated to postural control performance during voluntary reaching and hopping movements. Inherently important is the lack of any significant relationships between any of the tasks with the functional performance task (SLHST). Clinically these results support the utilization of a battery of tasks to determine overall postural control performance. Future research should be directed towards identifying which aspect of the postural control system each tasks optimally targets.

An Investigation Of Motor Control: The Static And Dynamic Balance Of Golfers

Stemm J, Green LB, Royer T: Tulane University, New Orleans, LA

The purpose of the study was to investigate the influence of motor control variables on the performance of golfers. This project is the first in an ongoing line of research composed of two phases, i.e., one involving the assessment of motor control variables, the second lending itself toward interventions for rehabilitation from injury and performance enhancement. This first investigation queried the relationship between measures of static and dynamic balance and three predetermined levels of golf handicaps. Fifty-two male subjects, aged 18-55, were divided into 3 groups according to handicaps (i.e., 0-9, 10-16, 17+) and were subjected to static and dynamic measures of balance using the "Balance Master", version 6.1 manufactured by Neurocom International, Inc. Subjects were required to undergo 10-second trials under the following conditions of static balance: (a) bilateral stance –eyes open (bso); (b) bilateral stance – eyes closed (bsc); (c) unilateral left stance –eyes open (uol); (d) unilateral left stance –eyes closed (ucl); (e) unilateral right stance –eyes open (uor); and (f) unilateral right stance – eyes closed (ucr). Dynamic balance was determined via a "limits of stability test" and "rhythmic weight shifts test" as measured by the "Balance Master" Neurocom International Inc. A one-factor (golf handicap) analysis of variance was used to test for significant between group differences in postural sway velocity for double and single leg stance trials, and differences in sway velocity and directional control for medial-lateral and anterior-posterior rhythmic weight shift trials. A .05 level of significance was used for all statistical procedures. There were no significant between-group differences in any of the measures of static or dynamic balance. As a result, it was concluded that there is no significant difference in measures of fundamental balance between scratch golfers and high handicappers. However, given that balance, in and of itself, does not serve the purpose of explaining these differences, it does open the door for investigating other mediating variables, e.g., cognitive self-talk, biomechanical efficiency, levels of psychological trust.

The Influence Of Ankle Orthoses And Exercise On Postural Stability

Jorden RA, Harter RA: Sports Medicine Research Laboratory, Oregon State University, Corvallis, OR

A wide variety of ankle orthoses are currently used to protect the ankle from injury or reinjury. Recent studies have suggested that the prophylactic effect of ankle orthoses may extend beyond their ability to limit pathological ranges of motion to an enhancement of proprioception. The purpose of this study was to identify the effects of ankle orthoses and vigorous exercise on postural stability by comparing the influence of three ankle orthoses (Aircast, Royce Medical, Swede-O), ankle taping, and a control condition on postural stability during unilateral stance before and after exercise. Fourteen healthy university students (8 males, 6 females) with no history of ankle sprain, ranging in age from 20 to 34 yrs (average, 22.9 yrs) participated in the study. Subjects were tested on five separate occasions within a two-week period; the order of orthosis application was counterbalanced. Three outcome measures obtained during Biodex Balance System unilateral stance testing were used to make comparisons between the experimental conditions: mediolateral sway index (MLSI), anterior/posterior sway index (APSI), and overall sway index (OSI). Talocrural and subtalar joint active ranges of motion (AROM) were measured before and after the exercise bout. We used a three-way (Ankle Orthoses x Pre/Post Exercise x Eyes Open/ Eyes Closed x Subjects) repeated measures ANOVA design. Pearson product moment (PPM) correlations were calculated for all dependent variables. The ankle orthoses we evaluated did not positively affect postural stability, as measured by MLSI, APSI, or OSI, in healthy subjects with no history of significant ankle sprain ($p > 0.05$). Removal of visual perception via blindfolding resulted in significant decreases in all three measures of postural stability ($p = 0.001$). The 20-minute exercise bout of slide boarding and stationary cycling did not influence the outcome variables, as postural stability was similar before and following exercise ($p > 0.05$). Post-exercise eyes-closed MLSI values ranged from 2.0 ± 0.46 for the Royce Medical brace to 2.3 ± 0.40 for the control condition, while APSI values ranged from 2.7 ± 0.96 for the Royce brace to 3.3 ± 1.22 for the tape condition ($p > 0.05$). The amount of inversion and eversion AROM permitted by the orthoses was not well correlated to the amount of postural sway measured ($r = .04$ to $.17$, $p > 0.05$). Our results suggest that the subjects used a hip strategy or a combined ankle-hip strategy in their efforts to control excessive sway induced by or Biodex testing protocol. This study was supported by Aircast, Inc.; Fitter, Inc.; Royce Medical, Inc., and Swede-O Universal, Inc.

Reliability Of Limits Of Stability Testing: A Comparison Of Two Dynamic Postural Stability Evaluation Devices

Hornyik ML, Harter RA: Sports Medicine Research Laboratory, Oregon State University, Corvallis, OR

Dynamic postural stability is the ability to move and control the center of gravity while maintaining a fixed base of support. This trait is evaluated clinically through tasks that involve leaning, reaching, and/or changing body direction. Reliable and sensitive measures of postural control are prerequisites for accurate assessment of sports injury status. The purposes of this study were: (a) to determine test-retest reliability for postural limits of stability (LOS) test data acquired on a NeuroCom Smart Balance Master and a Biodex Stability System, and (b) to compare test results for relationships between the evaluation techniques. Twenty-three healthy subjects (mean age, 23.8 ± 5.7 yr.) with no vestibular, visual, or lower-limb musculoskeletal deficits volunteered to participate. Subjects performed LOS tests on two occasions, seven days apart; the order of testing was counterbalanced. NeuroCom measures analyzed were directional control (NDC), endpoint excursion (NEE), and movement velocity (NMV); Biodex measures analyzed were directional control (BDC) and test duration (BTD). Intraclass correlation coefficients ($ICC_{2,1}$) were calculated using repeated measures ANOVAs, and were considered moderate at $.60 < ICC < .80$ and high at $ICC > .80$. Pearson product moment (PPM) correlations were calculated to evaluate relationships for each session; PPM correlations were considered significant at $a = .05$. Inter-day test-retest reliability was high for NEE ($ICC_{2,1} = .92$), NMV ($ICC_{2,1} = .85$), and BDC ($ICC_{2,1} = .82$). Moderate test-retest reliability was observed for NDC ($ICC_{2,1} = .73$) and BTD ($ICC_{2,1} = .71$). Session 1 PPM correlations revealed significant relationships between BTD and BDC ($r = -0.72$, $p = .001$), BDC and NEE ($r = 0.43$, $p = .037$), and BTD and NMV ($r = -0.53$, $p = .009$). Session 2 data indicated a significant relationship between BTD and BDC ($r = -0.67$, $p < .001$). We concluded that the clinical measures provided by the NeuroCom and Biodex systems had moderate to high test-retest reliability in our sample of healthy, young adults. While manufacturers claim their devices measure dynamic postural stability, the lack of significant correlations between the outcome variables from these devices leaves to speculation how these measures actually reflect dynamic stability and how these assessments should be interpreted in a clinical population. Our results suggest that each device measures unique characteristics of postural stability, and that further investigation is warranted to evaluate these differences.